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ABSTRACT

The curriculum guide is designed to provide students with realistic training in computer technology theory and practice within the secondary educational framework and to prepare them for entry into an occupation or continuing postsecondary education. Each unit plan consists of a description of the area under consideration, estimated hours of instruction, behavioral objectives, a module outline, a list of useful curriculum materials and resources, laboratory activities, and laboratory materials. The computer technology curriculum covers the following topics: computer careers in perspective (orientation), data preparation (media and forms), preparing paper tape, preparing mark-sense cards, preparing punched cards, computer familiarization, computer software, computer operation, computer programing, writing BASIC, other computer languages, systems analysis, systems programing, and computer center management. The document concludes with the facility layout of a suggested computer laboratory. (BP)

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Career Education Guide

COMPUTER TECHNOLOGY

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DEPARTMENT OF THE ARMY
DIRECTORATE
UNITED STATES DEPENDENTS SCHOOLS
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EDUCATION

Career Education - Computer Technology

This Career Education guide is an official publication of the Directorate, United States Dependents Schools, European Area. It is designed to serve as a curriculum guide for the computer technology cluster. The principal will establish adequate accountability procedures for all copies issued.

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FOREWORD

Twenty-five years ago the computer was a novelty in our society and unknown in the classroom. Now it pervades every aspect of modern life. Home computers and even pocket computers are already becoming commonplace. The opportunities for employment in this rapidly expanding market seem assured in the foreseeable future.

With the development of relatively inexpensive mini-computers and with large computer time-sharing capabilities available through telephone lines and terminals, it has become possible and, in fact, essential that secondary students be given the opportunity to prepare for careers in the computer technology field.

This program identifies and provides training for entry into numerous computer-related occupations and should stimulate a desire for continued study toward advanced positions in the field.

The program has the added attraction of providing a motivational resource to the general curriculum. It provides a meaningful laboratory for logical thinking and general problem solving. Students from the various disciplines--mathematics, sciences, the social studies--should be encouraged to explore the many applications of the computer as a learning tool. Even persons not working with or around computers will be exposed more and more to their effects.

Hardly a day goes by when the average person of our society is not touched by the influence of computer technology. Understanding computers and their supporting systems can help the modern citizens understand both the capabilities and the problems that this new tool creates for man.

This program takes into account the differing levels of equipment which various schools may possess. The hands-on activities are, of course, subject to the sophistication of the equipment. Students interested in the maintenance area of computer occupations should refer to the Electricity/Electronics Career Cluster for appropriate learning modules.

The Computer Technology Career Cluster chart suggests learning modules for achieving various occupational objectives. The preparation requirements chart indicates academic levels required for a variety of occupations in the field.

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PURPOSE OF THE GUIDE

This Career Opportunity Guide is prepared to assist in implementing a suggested learning system designed to provide the student with entry-level skills to numerous jobs in the broad field of Computer Technology. The system also provides a substantial base for the student who decides to extend his career potential by continuing professional study at a community college, a four-year college, or technical school.

This guide should also suggest to instructors of differing disciplines possible applications of the modules described to satisfy needs of students in their own areas. Cooperation among instructors and administrators and individual imagination are the only limiting factors.

The guide describes each of the elements in the system which will assist instructors and administrators in implementing the career program. It is not a study guide but includes enough information for the prospective instructor to plan his course with his own special requirements and preferences in mind.

In addition to the program outline, there are lists of references, equipment, and materials as well as distributor sources.

DESCRIPTION OF LEARNING SYSTEM

The Computer Technology Career Cluster is a two-year program which considers the needs, capabilities, background, and interests of each student enrolled. Instruction must, therefore, be individualized to the greatest extent possible considering the time and resources available. The routine classroom lecture should be reduced in its role as the primary teaching method. It should be used merely to introduce broad areas and should permit the students to discover details in small groups or on their own. Individualized learning depends heavily upon self-instructional materials, audio-visual learning aids, and student tutors.

To operate successfully, the learning environment must be free and open, but well ordered and managed with specific objectives in mind. Given such an environment, each student enters at his or her own level of achievement and moves along at his or her own rate of speed. A contract system may be used to monitor and improve upon the achievement rate. Progress is measured against individual performance rather than against that of the class as a whole. This allows students of all ability ranges to be in the same class. The high achievers can move ahead freely without being hampered by their slower classmates and can explore enrichment quests on their own. On the other hand, low achievers, already discouraged by repeated failures, are not threatened by further failure. They start wherever they are academically and attitudinally and immediately receive positive experiences which encourage them to progress.

Students need not accomplish modules in the same order. The instructor may prescribe or may negotiate with the student a selection of modules to accomplish a particular student's career goal, depending upon the student's interests and achievement level. Evaluation through pretesting may indicate that a student can skip over an entire module or part of a module.

The role of instructor becomes one of learning facilitator. The instructor prescribes the framework and procedures whereby the learner can accomplish the terminal performance objectives which will be consistent with the entry-level requirements for the career goal.

The wide cross section of learning modules suggested in this career cluster is designed to provide as great a selection of job entry-level skills as appears practical considering resource and time restraints. Individual requirements differ from school to school; therefore, the design of this learning system provides for the selection of modules to satisfy particular needs.

SUGGESTIONS FOR ORGANIZATION OF INSTRUCTION

The computer careers program may encompass far more than just the study of the following units on computer careers. Ideally and to be most effective, the environment for this program should include an actual computer center and computer with all phases of operating the center being performed by the students. In addition, the laboratory exercises in many of the course modules need the services of a computer operator which can be a role filled by trained students. An operating staff of students may also provide an enrichment to the curriculum in most other subject matter areas of the school by developing computer applications which are extensions of current courses.

The complete program as outlined requires a number of trained personnel, both students and teachers. The key person is, of course, the computer teacher/leader who will serve to coordinate the learning experiences of all others. There will need to be a number of teacher/users from other subject matter areas who will select application projects for development by the students. Initially, the student operating staff may be composed of one or two assigned as systems programmers and three to six assigned as computer operators.

The ideal student-operated computer center would have all positions filled with students starting at the beginning of the school year. However, in most cases, this may not be possible due to the lack of trained personnel. When enough trained students are unavailable, several may be trained rapidly to fill the essential roles of computer operation. Then, as other students progress to this point, they will take over, allowing the first students to go on to other roles in the computer center. Also, natural variation among the students will allow some to progress through the self-study units faster or will allow some to stop at certain units for longer periods of time to study the subjects to a greater degree.

The normal progression within the course follows the sequence of the modules. Any student may follow a different route depending on his or her interest, ability or experience. Also, the amount of involvement in the project assignments for each unit may vary from student to student for the same reasons.

As the school term progresses, most students in the regular Computer Technology Career Cluster will have progressed beyond the first several modules. To fill the roles of data preparation clerk and computer operator, students may be brought in from other areas, such as the business occupations career area, to gain experience in Computer Technology.

Schools will obviously fit into one of three categories: the school which has a computer that is available to students, the school that makes only remote terminal access to a computer available for student use, and the school that has no provision for access to a computer available for students. The learning system provides for all three conditions. The Elements of Computer Careers-User's Guide, Northwest Regional Educational Laboratory, suggests procedures for training students and teachers to operate the program in any of the three modes. There are also suggestions made for preparing teacher/users to help develop application projects which can be of mutual benefit to different subject areas.

A separate branch has been included in the career cluster to accommodate students interested in computer maintenance. These students will be working primarily in the Electricity/Electronics career area, but should be provided the opportunity to become familiar with the computer center and its operation. Actual maintenance of equipment will, of course, be restricted to qualified personnel.

ERIC

INSTRUCTOR OBJECTIVES

In order to facilitate the student's completion of performance objectives in the learning system and to provide for necessary management, the following list of instructor objectives is recommended:

1. Acquaint students with class procedures.

2. Provide students with assistance in module sequencing with career goals in mind.

3. Establish small groups for study and activity purposes.

4. Encourage peer tutoring.

5. Distribute all module objectives to students and assist in relating these objectives to entry-level skill requirements.

6. Assist students in completing performance objectives by providing demonstrations of skills and concepts for each module of instruction.

7. Develop individual contracts with students defining related learning activities.

8. Provide opportunities where students can observe the activities of individuals in a variety of jobs in the career field and assist students to relate the educational goals of the learning system to the development of entry-level skills.

9. Construct and evaluate pre-tests and post-tests for each module.

10. Construct reading assignment and audio-visual review lists for each module.

11. Provide trays, drawers, or learning stations with the appropriate materials and instructions to complete laboratory activities.

12. Maintain an attractive and stimulating working environment and encourage students to display their projects or materials collected from related fields of study.

13. Invite guest speakers to discuss appropriate topics related to the field of study.

14. Encourage and actively recruit students of different disciplines to work on modules in this career cluster which may have applications for their field.

15. Encourage students working in this career cluster to examine objectives of modules in other areas with a view toward possible application to their goals.

COMPUTER TECHNOLOGY CAREER CLUSTER CHARTS

The curriculum of the Computer Technology Career Cluster is designed to prepare students for entry into one of a broad selection of occupations or continuing post-secondary education.

The relationship of the courses or modules to preparation for entry into particular jobs has been shown on the wall charts labeled:

- Computer Technology Career Cluster

- Preparation Requirements for Computer Technology Careers

COURSE MODULES AND LENGTH OF INSTRUCTION

This career cluster as outlined allows for a variety of career programs ranging from less than a semester to two years of training. Since the curriculum is individualized and students work at different rates of performance, it is difficult to specify exact times for accomplishment. The following list, therefore, shows an approximation of the average student time it takes to accomplish the performance objectives and is useful only as a general reference for planning.

Module	Estimated Learning Time in Hours
Orientation - Computer Careers in Perspective	12
Data Preparation (Media and Forms)	12
Preparing Paper Tape	12
Preparing Mark-Sense Cards	10
Preparing Punched Cards	40
Computer Familiarization	12
Computer Software	5
Computer Operation	25
Computer Programming	38
Writing BASIC	25
Other Computer Languages	45-90
Systems Analysis	60
Systems Programming	60
Computer Center Management	38
Principles of Electronics with skills training	see Electricity/Electronics
Transistor Applications with skills training	see Electricity/Electronics
Logic Circuit Design with skills training	see Electricity/Electronics
Integrated Circuit Design with skills training	see Electricity/Electronics

ORIENTATION - COMPUTER CAREERS IN PERSPECTIVE

This module was originally designed to follow the other elements of this program. It is, however, an excellent introduction to the program as well. There is more material included than can be covered in the suggested learning time. The instructor will, therefore, want to pick out the highlights which will best fit his intentions in the introductory course. The module may then be repeated in expanded form at the end of the program.

DESCRIPTION

This module is a general summary of the types of career opportunities available in the computer field. It covers the fields of business and industry, scientific research, and education. Computer applications in these areas are described with specific examples of projects which a person might work on if he were to be employed in that area.

LEARNING TIME

Hours: 12

OBJECTIVES

Given the appropriate instruction, the student will know:

1. The impact of computers.
2. Computers and social change.
3. Some uses of computers.
4. Modern applications of computers in business.
5. The future of computers in business.
6. Application of computers in scientific research.
7. The future of computers in scientific research.
8. Applications of computers in education.
9. The future of computers in education.

The student's knowledge of computers will be considered acceptable if he answers 80% of the questions correctly when given a fifteen-minute objective test.

MODULE OUTLINE

A. Computers in the Modern World

B. Computers in Business and Industry

C. Computers in Scientific Research

D. Computers in Education

E. Careers and Computers

CURRICULUM MATERIALS

Computer Careers in Perspective (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Course 2 for Teachers, Tecnica Education Corporation, 1864 S. State Street, Suite 100, Salt Lake City, Utah 84115

Book 1: Business Education: Application Units

Book 2: English: Application Units

Book 3: Mathematics: Application Units

Book 4: Science: Application Units - Volume I and Volume II

Book 5: Social Studies: Application Units

Filmstrips: Universal Education and Visual Arts, 100 Universal City Plaza, Universal City, California 91608

"Man the First Computer" #17741

"The Miracle of the Computer" #17742

"The Computer in your Life" #17743

"Opportunities Unlimited" #17744

(with record or cassette)

Film: Aims Instructional Media Services, P. O. Box 1010, Hollywood, California 90028

Career Awareness - Computer Industry Series

"Information Explosion" #9336, 11 minutes color, 16mm

LABORATORY ACTIVITIES

None specified

LABORATORY MATERIALS

None specified

DATA PREPARATION
(MEDIA AND FORMS)

DESCRIPTION

The basics of how data are transmitted and registered is the starting point of this module. How raw data are prepared using input media in the form of coded marks or holes is explained. The three most common media used for encoding data for computers are reviewed, and the process of preparing mark-sense cards, punched cards, and paper tape is described. The form that raw data comes to the preparation clerk concludes this module.

LEARNING TIME

Hours: 12

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Chart the flow of data processing.
2. Number in the proper order the steps in which data moves into the computer.
3. Describe the data clerk's responsibility.
4. Describe the difference in preparation of a mark-sense card from a punched card.
5. Select four characteristics of raw data from a list of six in an objective test.
6. Identify the purpose and characteristics of coding forms in an objective test.
7. Identify the purpose and characteristics of data source documents in an objective test.

Acceptable achievement will be determined by teacher observation, in class discussion, and a minimum of 80% success in objective tests.

MODULE OUTLINE

A. Introduction to the Job

B. Communicating with the Computer

C. Introduction to the Media

D. Raw Data for Data Preparation

E. Source Documents and Instructions

CURRICULUM MATERIALS

The Elements of Data Preparation (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Course 1 for Teachers/Administrators, Tecnica Education Corporation, 1864 S. State Street, Suite 100, Salt Lake City, Utah 84115

Book 1: REACT and the Computer in Education

LABORATORY ACTIVITIES

None specified

LABORATORY MATERIALS

None specified

PREPARING PAPER TAPE

DESCRIPTION

The purpose of punched paper tape and its application are discussed in this module. Students are introduced to the teletypewriter and its function is explained. They become familiar with the design of paper tape, and the ASCII code is described. Through laboratory activities, students learn to operate the teletypewriter and prepare a punched paper tape.

LEARNING TIME

Hours: 12

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Describe the reason for the small holes running the length of the paper tape.
2. Give the number of positions used by the ASCII code.
3. Use the ASCII code table to decode a message on punched paper tape.
4. Describe when teletypewriters are used for preparing data.
5. Identify the key elements of a teletypewriter.
6. Start, type a message correctly, and turn off an acoustic-coupled or directly connected teletypewriter.
7. Prepare, punch, and check a paper tape.

Acceptable achievement will be determined by successful accomplishment of laboratory exercises and a minimum of 80% success in objective tests.

MODULE OUTLINE

A. Introduction to Paper Tape

B. The Teletypewriter

C. The Teletypewriter's Paper Tape Punch and Reader

D. The Prepared Tape

CURRICULUM MATERIALS

The Elements of Data Preparation (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Course 1 for Teachers/Administrators, Tecnica Education Corporation, 1864 S. State Street, Suite 100, Salt Lake City, Utah 84115

Book 3: Man-Machine Languages

Book 4: Using the Teletype

Film: Coronet Instructional Materials, 65 E. South Water Street, Chicago, Illinois 60601

"Data Processing: An Introduction" 13 minutes color, 16mm

LABORATORY ACTIVITIES

1. Preparing data using the teletypewriter
2. Exercises in preparing paper tape; prepare NSORT program on paper tape; prepare quarter test grade data
3. Have NSORT program run through computer; make corrections

LABORATORY MATERIALS

Teletypewriter - acousti-coupled or direct-connected with punch and reader devices

Paper tape

Teletype coding form provided

NSORT source document provided

Quarter test grade data source document provided

Computer which reads FORTRAN language

PREPARING MARK-SENSE CARDS

DESCRIPTION

The purpose and characteristics of mark-sense cards are discussed in this module. The 40-column mark-sense card is specifically described, and Hollerith code is explained in detail. Procedures for encoding numbers, letters, and symbols using Hollerith code, and conventions in preparing mark-sense cards conclude the module. Laboratory exercises provide experience in preparing this type of data media.

LEARNING TIME

Hours: 10

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Select the best statements, when tested, which best describe mark-sense media.
2. Encode properly a 40-column mark-sense card with the data provided.
3. Describe from what was covered in this module, what the "conventions" are good for.
4. Prepare a program on mark-sense cards using the coded sheet provided.
5. Prepare data on mark-sense cards using instruction sheets provided.

Acceptable achievement will be determined by successful accomplishment of laboratory exercises and a minimum of 80% success in objective tests.

MODULE OUTLINE

A. The Mark-Sense Card

B. Encoding Mark-Sense Cards

C. Conventions in Preparing Mark-Sense Cards

CURRICULUM MATERIALS

The Elements of Data Preparation (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

LABORATORY ACTIVITIES

1. Prepare NSORT program on mark-sense cards using the coding sheet provided
2. Prepare quarter test grade data on mark-sense cards using instruction sheets provided
3. Have the program and data cards run through the computer and make necessary corrections

LABORATORY MATERIALS

40 column mark-sense cards

No. 2 pencil

Coding and instruction sheets provided

Computer which reads FORTRAN

PREPARING PUNCHED CARDS

DESCRIPTION

The importance and function of punched cards in data preparation is discussed in this module. The student becomes familiar with the characteristics of the cards themselves, and then learns how to operate a conventional keypunch machine and how to prepare data using it.

LEARNING TIME

Hours: 40

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Identify the characteristics of punched cards.
2. Identify the zone and digit rows on punched cards.
3. Identify the differences between mark-sense cards and punched cards.
4. Identify true statements about "fields" on cards.
5. Identify items data clerks must look for when keypunching cards.
6. Identify true statements regarding keypunch machines.
7. Number in the correct order the five steps a card goes through when it is prepared on a keypunch machine.
8. Identify the switches used to run a keypunch machine.
9. Correctly encode data from standard job instruction documents using the keyboard on a typical keypunch machine such as the IBM 26 or 29.
10. Punch cards from a variety of source documents, conforming with industry standards of speed and accuracy.

Acceptable achievement will be determined by successful accomplishment of laboratory exercises and a minimum of 80% success on objective tests.

MODULE OUTLINE

A. Punched Cards - Characteristics and Functions

B. The Keypunch Machine - Purpose and Operation

C. Finger and Keyboard Exercises

CURRICULUM MATERIALS

The Elements of Data Preparation (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S.W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Key-Punch Training Course (text), stock #K17, William E. Bux. South-Western Publishing Company, 855 California Avenue, Palo Alto, CA 94304

Key-Punch Training Course Kit #K171, includes: Job Instructions for Key-Punch Training Course and punched cards for keyboard exercises

Manual for Key-Punch Training Course, stock #K17M

Course 1 for Teachers/Administrators, Tecnica Education Corporation, 1864 W. State Street, Suite 100, Salt Lake City, Utah 84115

Book 3: Man-Machine Languages

LABORATORY ACTIVITIES

1. Check out on the basics of operating a keypunch machine such as IBM model 26 or 29
2. Prepare simple data on punched cards using coding sheets provided
3. Check data prepared
4. Punch cards in rapid sequence
5. Punch cards in automatic sequence
6. Prepare the NSORT program on punched cards using the coding form provided
7. Prepare quarter test grade data on punched cards using the instruction sheets provided
8. Have the program and data cards run through the computer and make necessary corrections
9. Prepare cards for jobs 1 to 12 using Job Instructions for Key-Punch Training Course

LABORATORY MATERIALS

80 column punch cards

Keypunch machine such as IBM model 26 or 29

Source materials provided

Computer which reads FORTRAN

Job instructions booklet (Key-Punch Training Course)

Punched cards for finger and keyboard exercises (Key-Punch Training Course)

Punched cards for jobs 1 to 12 (Key-Punch Training Course)

COMPUTER FAMILIARIZATION

DESCRIPTION

This module covers the job of the person who actually runs the computer and other pieces of associated equipment such as input and output devices. Types of input-output devices, their description and function are described. The central processing and storage units are also examined. Finally, the computer console is explained prior to actually using a computer in laboratory exercises.

LEARNING TIME

Hours: 12

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Describe the job, skills required, and working conditions of a computer operator.
2. Identify and describe characteristics and functions of the following input devices:
   a. punched card reader
   b. paper tape reader
   c. magnetic tape drive
   d. magnetic disk drive
   e. magnetic drum drive
   f. mark-sense reading devices
   g. console typewriter
   h. teletypewriter
3. Identify and describe characteristics and functions of the following output devices:
   a. line printer
   b. card punch
   c. paper tape punch

d. magnetic output devices

e. teletypewriter output

f. cathode ray tube

4. Identify and describe characteristics and functions of the following processing units:

   a. storage unit

   b. arithmetic/logic unit

   c. control unit

5. Identify the basic components of a computer console and describe their function.

6. Run a simple program, using job control statements provided, and working under supervision of the teacher or computer operator.

Acceptable achievement will be determined by successful accomplishment of laboratory exercises and a minimum of 80% success in objective tests.

MODULE OUTLINE

A. The World of the Computer Operator

B. Introduction to Computer Processing and Hardware

C. Input Devices

D. Output Devices

E. Central Processing Unit

F. Computer Console

CURRICULUM MATERIALS

The Elements of Computer Operation (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Film: BFA Educational Media, 2211 Michigan Avenue, Santa Monica, California 90404

"Computers" 10 minutes color, 16mm

LABORATORY ACTIVITIES

1. Run a simple program using program and data input provided and a list of appropriate job control statements
2. List the steps followed, in proper sequence, in preparing the job control statements and running the computer

LABORATORY MATERIALS

Computer and appropriate input-output devices

Program and data input provided by teacher or computer operator

Job control statements

COMPUTER SOFTWARE

DESCRIPTION

The less visible, but all important part of the computer system, software, is discussed in this module. Software refers to all of the programs that make the computer function. Several important types of programs which affect the operating system are dealt with. Modes of operation and the electronic language used by the computer (binary code) are explained.

LEARNING TIME

Hours: 5

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Identify the functions and characteristics of the following types of programs:
   a. the supervisor program
   b. input-output control programs
   c. utility programs
   d. translators
2. Identify assemblers and compilers.
3. Identify characteristics of "batch" and "on-line" processing.
4. Recognize advantages and disadvantages of "batch" and "on-line" processing.
5. Describe the means by which information is stored in the computer's main storage bank.
6. Describe what carries data to main storage.
7. Identify what a binary code is.
8. Represent two digit numbers in binary code.

Acceptable achievement will be determined by a minimum of 80% success in objective tests.

MODULE OUTLINE

A. The Operating System

B. Modes of Computer Operation

C. Data in the Computer

CURRICULUM MATERIALS

The Elements of Computer Operation (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Filmstrips: Computer Series III, #3A4000, BFA Educational Media, 2211 Michigan Avenue, Santa Monica, California 90404

"Binary Numbers" parts 1 and 2

"Binary Numbers at Work" parts 1 and 2

4 filmstrips, 2 cassettes

LABORATORY ACTIVITIES

Practice converting numbers to binary code

LABORATORY MATERIALS

None specified

I

COMPUTER OPERATION

DESCRIPTION

This module is designed to take the student step by step through a typical day of computer operation. Some guidelines on dealing with problems in the runs and on handling the data media are given. Finally, an exercise in computer operation is presented in which the student is expected to take the role of the operator and to perform typical tasks such as filling out logs, making decisions, and interpreting information.

LEARNING TIME

Hours: 25

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Make up a daily work schedule using the information given on the master schedule and instruction sheets provided.
2. Correct or improve the prepared work schedule using the model provided.
3. Prepare a diagram to show how the equipment for the job described should be set up.
4. Dry run the job on paper, answering questions correctly, and making proper decisions about malfunctions.
5. Document the job using the job card provided.
6. Define the terms "decollate" and "burst."
7. Set up, run, document, and handle output for the NSORT program using program and data media prepared in earlier laboratory exercises.

Acceptable achievement will depend upon the degree of success accomplished in the dry run exercise and actual computer run of NSORT program.

MODULE OUTLINE

A. Preparing the Daily Work Schedule

B. Running the First Job - on Paper

C. Running the Grading System Job - on the Computer

CURRICULUM MATERIALS

The Elements of Computer Operation (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

LABORATORY ACTIVITIES

Set up, run, document and handle output for the Grading System Job using the NSORT program and data media prepared in earlier laboratory exercises.

LABORATORY MATERIALS

Computer which reads FORTRAN

Prepared input media to fit the computer:

a. paper tape

b. mark-sense cards

c. punched cards

Job log

Job setup sheet

Trouble log

Distribution sheet

Daily work schedule

Job stream flowchart

COMPUTER PROGRAMMING

DESCRIPTION

The first part of this module describes the computer programmer, what he does, skills required, his function in the computer center, and career paths he may follow. The tools and techniques of his job, including the process of flowcharting are reviewed next. Programming languages are examined; also program debugging and documentation are explained.

LEARNING TIME

Hours: 38

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Identify and describe symbols commonly used in flowcharting.
2. Fill in on a flowchart the three elements found in any computer problem.
3. Describe briefly the term "machine language."
4. Identify the code commonly used in machine language.
5. Identify types and characteristics of four categories of programming language.
6. Identify three high-level computer languages commonly used by programmers in writing programs.
7. Identify characteristics and functions of the three high-level programming languages.
8. Identify steps in debugging a program.
9. List in proper order steps commonly taken to debug a program.
10. Identify aids to the programmer in debugging programs.
11. Identify check points in the tracing procedure.
12. Identify methods of tracing data in storage in the computer.
13. Define a correctly compiled program.
14. Identify the procedure and characteristics of testing a program on a computer.

15. Identify two general types of documentation and their characteristics which the programmer is responsible for.

16. Identify three types of reference manuals used by programmers.

Acceptable achievement will be determined by successful accomplishment of laboratory exercises and a minimum of 80% success in objective tests.

MODULE OUTLINE

A. The World of the Computer Programmer

B. Flowcharting

C. Programming Languages

D. Debugging a Program

E. Documenting a Program

F. Reference Manuals

CURRICULUM MATERIALS

The Elements of Computer Programming (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Course 1 for Teachers/Administrators, Tecnica Education Corporation, 1864 S. State Street, Suite 100, Salt Lake City, Utah 84115

Book 2: Flowcharts and Algorithms

Book 3: Man-Machine Languages

Filmstrips: Computer Series II, #3A3000, BFA Educational Media, 2211 Michigan Avenue, Santa Monica, California 90404

"Introduction to Computer Programming"

6 strips, 3 cassettes

LABORATORY ACTIVITIES

1. Flowchart computer problems using materials provided

2. List steps an assumed program must take given information provided

LABORATORY MATERIALS

Information sheets for flowchart exercise

WRITING BASIC

DESCRIPTION

This module explains in general terms just what a computer program is. It then goes into detail describing one type of high-level computer language, BASIC. Finally, the student is shown the fundamentals of programming BASIC in order to understand and write original programs in this computer language.

LEARNING TIME

Hours: 25

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Describe what the computer can and cannot do.
2. Communicate with the computer by means of the teletypewriter.
3. Read and understand BASIC programs written by others.
4. Write programs using BASIC computer language.
5. Invent original problem solving procedures using BASIC programming language.

Acceptable achievement will depend upon successful completion of the exercises in the Tecnica BASIC volume I workbook.

MODULE OUTLINE

A. Getting Started
   1. the keyboard
   2. baby talk

B. Moving On
   1. numerical expressions
   2. the PRINT statement
   3. floating point numerals
   4. printing messages

5. exponents - computing a power of a number
6. variables
7. variable expressions

C. Feeding the Beast
1. the input statement
2. the GO TO statement
3. READ and DATA statements
4. more messages

D. You Can Count On It
1. loops
2. loops exposed

E. Encore
1. FOR - NEXT loops
2. the STEP clause
3. variable FOR statements
4. extra for experts

F. Function Junction
1. the INT function
2. the square root function
3. look both ways

CURRICULUM MATERIALS

Teach Yourself BASIC (text), volume I, Tecnica Education Corporation, 1864 S. State Street, Suite 100, Salt Lake City, Utah 84115

LABORATORY ACTIVITIES

Teach Yourself BASIC is a programed learning workbook with activities demonstrating each of the concepts listed in the outline.

LABORATORY MATERIALS

Teach Yourself BASIC, volume I, Tecnica Education Corporation

Teletypewriter

Computer (exercises were checked out on the TEC 211 computer. There may be differences if the problems are worked on a different type of computer)

OTHER COMPUTER LANGUAGES

DESCRIPTION

This module is designed to familiarize the student with various computer languages beyond BASIC and their advantages and differences. The languages to be emphasized must be compatible with the computer equipment available to the student. Several programming languages are common to most computers. These are covered in this module as well as several machine language assemblers which are specific to the Digital PDP-8/E computer. The module may be presented as an introduction to other computer languages or as an extended program affording the student some fluency in certain of the languages.

LEARNING TIME

Hours: 45 - 90

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Describe the differences between high-level computer languages and machine languages.
2. Describe the process of compiling a computer program.
3. Define the terms commonly used in programming languages.
4. Describe the basic functions of an assembler language.
5. List the steps in assembling a source program in an assembler language.
6. Differentiate between pseudo- and macro-instructions.
7. Define the terms used in assembler languages.
8. List the kinds of problems programmed in FORTRAN.
9. Describe the major elements of FORTRAN.
10. State the purpose of subprograms and subroutines of FORTRAN.
11. Describe the methods by which subprograms and subroutines are used by the main FORTRAN program.
12. Define the terms used in FORTRAN.
13. Describe the advantages of the COBOL language.

14. Describe the basic functions of COBOL.

15. Define the word classifications and the major divisions of COBOL.

16. Describe the PL/I language, its advantages and major elements.

17. Describe the RPG language, its advantages and major elements.

18. Define selected terms of other high-level languages.

Acceptable achievement will be determined by successful accomplishment of laboratory activities and a minimum of 80% success on written and objective tests.

MODULE OUTLINE

A. Fundamentals of Computer Languages
   1. elements of a program
   2. basic programming languages
   3. the compiler
   4. how the computer uses the machine language

B. Assembler Languages and Macro-instructions
   1. assembling the program
   2. elements of an assembler language
   3. functions of an assembler language
   4. pseudo-instructions
   5. macro-instructions

C. FORTRAN
   1. advantages and basic functions of FORTRAN
   2. writing FORTRAN programs
   3. FORTRAN notation
   4. FORTRAN arithmetic statements
   5. input-output statements
   6. control and transfer of control statements
   7. procedure statements

D. COBOL
   1. advantages of the COBOL language
   2. elements of COBOL
   3. rules of coding

E. Other High-level Languages

1. advantages of PL/I
2. elements of the PL/I language
3. advantages of RPG languages
4. elements of RPG
5. the ALGOL language

F. Languages for the PDP-8/E Computer

1. interactive languages
   a. FOCAL-8
   b. 8K BASIC
2. compiler language - 8K FORTRAN
3. machine language assemblers
   a. 4K assemblers
   b. 8K assemblers

CURRICULUM MATERIALS

Elements of Data Processing (text), Ellen Marxer. Delmar Publishers, Inc., 50 Wolf Road, Albany, NY 12205

Elements of Data Processing Teacher's Manual. Delmar Publishers, Inc.

Introduction to Programming (text), Digital Equipment Corporation, 146 Main Street, Maynard, MA 01754

Programming Languages (texts), Digital Equipment Corporation

FOCAL 8

8K BASIC

8K FORTRAN/SABR Assembler

4K Assembler, PAL III, MACRO-8

8K Assembler, SABR/PAL 8

Suggested references: Elements of Computer Programming: FORTRAN, Ellen Marxer, Donald Hartford. Delmar Publishers, Inc.

Computer Programming with COBOL, Ellen Marxer, Donald Hartford. Delmar Publishers, Inc. Instructor's Guide available

A FOCAL Primer, Howard C. Howland, Cornell University, Ithaca, NY 14850

LABORATORY ACTIVITIES

See curriculum materials

LABORATORY MATERIALS

See curriculum materials

SYSTEMS ANALYSIS

DESCRIPTION

What the systems analyst does, the requirements for the job, and how the position fits with other tasks of the computer center are discussed in this module. The student becomes familiar with basic concepts and tools used by systems analysts in their work, including the "systems approach" and macro flowcharting techniques. Typical problems encountered by systems analysts are described. Finally, the student assumes the role of systems analyst and is led through a simulated systems problem on paper.

LEARNING TIME

Hours: 60

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Identify what a systems analyst does, requirements for the job, and the analyst's position in the computer center organization.
2. Define "systems approach."
3. List steps of systems approach in proper order.
4. List steps to solve an assumed problem on flowchart provided.
5. Identify characteristics of macro and micro flowcharts.
6. Identify characteristics of decision tables.
7. Complete decision tables using information provided.
8. Complete macro flowcharts using information provided.
9. Identify characteristics and functions of input and output forms.
10. Identify purpose and procedures for testing programs.
11. Define documentation of a system.
12. Define implementation of a system.

Acceptable achievement will be determined by successful accomplishment of the laboratory case problem and a minimum of 80% success in objective tests.

MODULE OUTLINE

A. The World of the Systems Analyst

B. The Systems Approach

C. Defining the Output and Input

D. Designing the System

E. Testing and Implementing the System

CURRICULUM MATERIALS

The Elements of Systems Analysis (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S.W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

Course 1 for Teachers/Administrators, Tecnica Education Corporation, 1864 S. State Street, Suite 100, Salt Lake City, Utah 84115

Book 5: The Social Impact of Computers

Book 7: Computers in Instruction

Book 8: Computers in School Administration

Book 9: Computers in Guidance, Testing and Libraries

Book 10: REACT Unit Tests

Suggested references: Advanced Problems, Bob Albrecht, Software Distribution Center, Digital Equipment Corporation (DEC), Maynard, Massachusetts 01754

BASIC Application Programs - CHEMISTRY, (DEC)

The Guide to Simulations/Games for Education and Training, David W. Zuckerman, Robert E. Horn, 2nd edition, Information Resources, Inc., P.O. Box 417, Lexington, MA 02173

LABORATORY ACTIVITIES

1. Draw up flowcharts and forms as requested in case study, Part III, A Systems Problem, found in The Elements of Systems Analysis, (NREL)

2. Using the systems approach practiced in Part III, select a problem from another area of study (Social Studies, P.E., Life Science, etc.) and develop a computerized system which will provide solutions - teaming with other class members is recommended and the instructor of the other study area may serve as the client

LABORATORY MATERIALS

Case study, Part III, A Systems Problem, The Elements of Systems Analysis, (NREL)

SYSTEMS PROGRAMMING

DESCRIPTION

A general picture of the systems programmer's job, its requirements, and its rewards is discussed in the beginning of this module. Various parts of systems software are examined, and a description of the techniques and tools the systems programmer uses in designing the software components are presented. Examples of two different programmers at work conclude this module.

LEARNING TIME

Hours: 60

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Identify what a systems programmer does, requirements for the job and its rewards.
2. Identify characteristics of early computers before software development.
3. Describe the two most important functions of software.
4. Identify characteristics and functions of the following:
   a. assemblers
   b. macro instructions
   c. compilers
5. Define "computer operating system."
6. Identify characteristics and functions of the following operating systems:
   a. supervisor program
   b. input/output control program
   c. utility program
7. Identify the computer language most often used by systems programmers.
8. Identify the characteristics and functions of macro and micro flowcharts as they pertain to systems programmers.

9. Identify steps taken by a systems programmer in debugging a program.

10. Identify types and purposes of documentation produced by systems programmers.

11. List in proper order steps normally taken in developing the translator part of an assembler.

12. Translate into machine language a program using information sheets also provided.

13. Identify fundamental elements of a supervisor program.

14. List in proper order the steps involved in creation of a software system.

15. Identify characteristics and tasks of the manufacturer's systems programmer and the user's systems programmer.

Acceptable achievement will depend upon successful accomplishment of the laboratory exercises and a minimum of 80% success on objective tests.

MODULE OUTLINE

A. The World of the Systems Programmer

B. Before Software

C. Translators

D. The Operating System

E. Programming Languages

F. Flowcharting Techniques

G. Debugging the Program

H. Documentation

I. The Manufacturer's Systems Programmer

J. The User's Systems Programmer

CURRICULUM MATERIALS

The Elements of Systems Programming (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

CARDIAC Instructional Manual, American Machine Foundry, 1025 N. Royal Street, Alexandria, Virginia 22314

LABORATORY ACTIVITIES

1. Work exercises from part V of Elements of Systems Programming (NREL) using the CARDIAC computer kit.
2. Write, document, and implement an original program which may be added to the systems library. This program must add to the efficiency or usefulness of the computer system being used for classroom work.

LABORATORY MATERIALS

Part V of Elements of Systems Programming

CARDIAC computer kit

Operating handbook of the computer being used in the classroom

COMPUTER CENTER MANAGEMENT

DESCRIPTION

A description of what the various management jobs are, what the requirements for these jobs are, and how managers influence the operation of the computer center are subjects for the beginning of this module. The kinds of problems that managers must deal with and some of the techniques for solving them are presented. Finally, the student plays the role of a manager faced with typical problems which require decisions.

LEARNING TIME

Hours: 38

OBJECTIVES

Given the appropriate instruction and materials, the student will be able to:

1. Identify what the various management jobs are, requirements for doing them, and their influence on the operation of the computer center.
2. Identify useful techniques, characteristics, and procedures associated with the management of:
   a. personnel
   b. facilities and equipment
   c. budget
   d. relationships with other organizations

Acceptable achievement will depend upon successful accomplishment of laboratory exercises and a minimum of 80% success on objective tests.

MODULE OUTLINE

A. The World of the Computer Center Manager

B. Personnel Management

C. Facilities and Equipment Management

D. Budget Management

E. Relationships with Other Organizations

CURRICULUM MATERIALS

The Elements of Computer Center Management (text), Computer Technology Program, Northwest Regional Educational Laboratory (NREL), 710 S. W. Second Avenue, Portland, Oregon 97204

The Elements of Computer Careers User's Guide, Computer Technology Program, (NREL)

LABORATORY ACTIVITIES

Three case studies requiring management decisions are provided:

1. A Budget Problem
2. A Personnel Problem
3. A Supplies Problem

LABORATORY MATERIALS

The Elements of Computer Center Management Part III, Computer Technology Program, (NREL)

SUGGESTED FACILITIES LAYOUTS

The facilities descriptions and layout sketches following are intended only as guides. Any number of alternative facility plans could work equally well. For some schools, facilities for this program may already exist. In such cases, the following material may offer the instructor and administration some suggestions for making the facility more effective through minor alterations.

For other schools starting up a new program, it may be necessary to remodel existing facilities. In such cases, it should not be expected that the remodeled facilities will offer every advantage that can be achieved with new facilities.

Even if new facilities are to be provided, a school may be unable to support a complete laboratory either because of enrollment, space, staff, or financial limitations. In such cases, decisions must be made regarding minimum program essentials and then facilities designed to fit.

Whether new or remodeled, facilities may serve multiple or joint functions. Thus business and graphics production areas may be combined; art and graphics study areas could be shared; welding can be done in an auto shop; small engine and automotive shops can be combined; computer and business programs may share spaces; the various health and cosmetology programs can share a common suite; the electronics laboratory could be combined with a physical science laboratory.

Such combinations have served elsewhere to strengthen both programs. Students see the direct relationship of what they are doing with careers in another field, and faculty find professional stimulation and mutual support in working with colleagues in what have often been artificially separated disciplines.

COMPUTER TECHNOLOGY LABORATORY

The laboratory space required to house the computer technology program requires very little modification of a traditional high school laboratory space. Or two adjacent standard classrooms could readily be used by providing direct access between them. If two such spaces are used, it is desirable to convert as much of the dividing wall as possible to glass so that one instructor can supervise both areas. If two separate spaces are utilized, the laboratory functions should be divided so that the lecture/briefing/planning area is maintained in one room and the machines and programing areas confined in another.

Special utility requirements are minimal. Electrical outlets for 110 and 220 volts should be provided for each machine station in the input/readout area. In addition, 110 volt outlets should be provided at the work area stations so that electrical typewriters, calculators, and audio-visual hardware can be utilized there if desired. The teacher's station should also have access to a 110 volt outlet for the overhead projector.

Telephone line connections for the computer terminal are required.

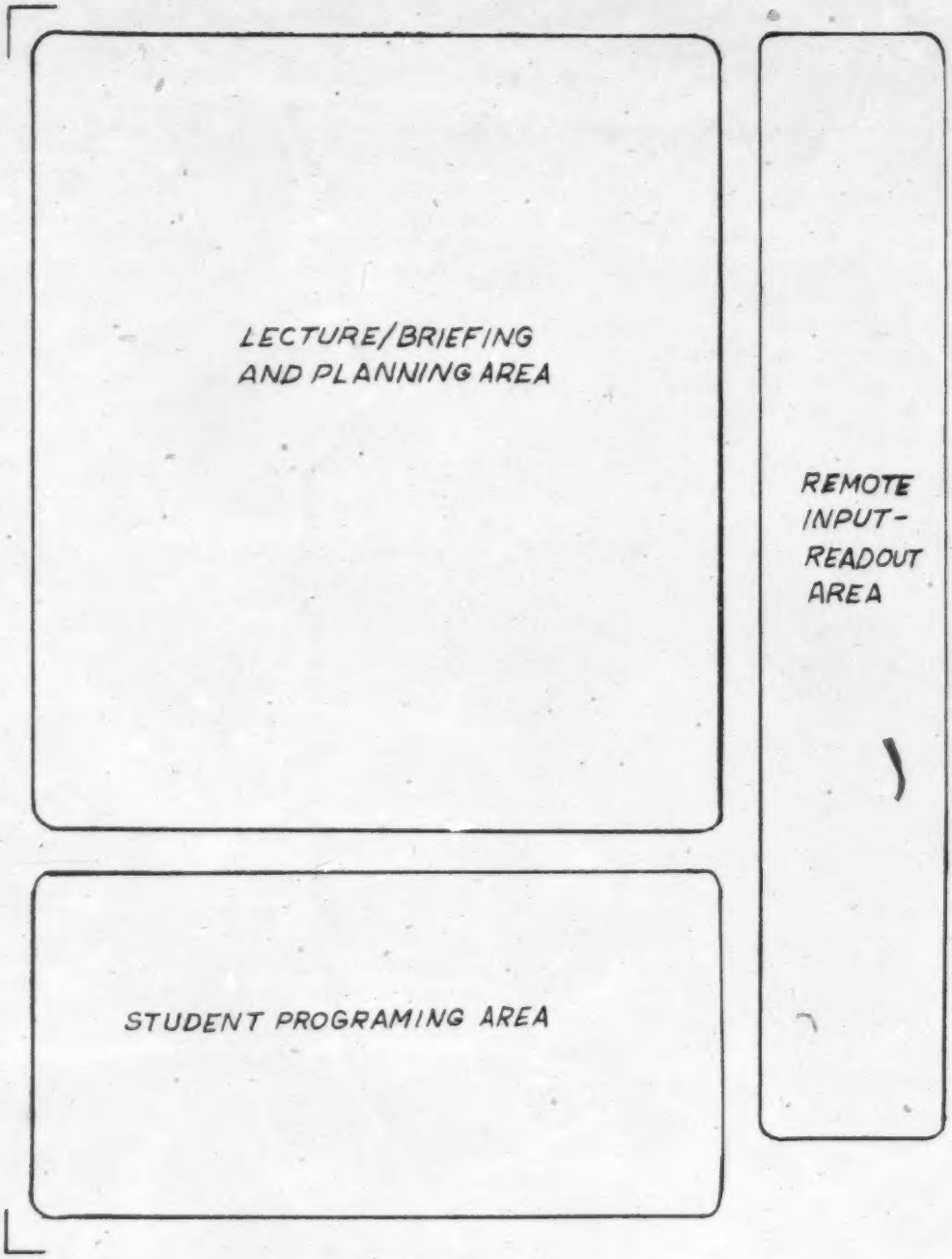
Good lighting is required throughout and 100 footcandles at tabletop height is recommended. Shadowless lighting similar to that required for drafting is highly desirable.

Because the machines tend to be noisy, acoustical treatment is important. Carpeting and ceiling acoustical treatment are recommended. Cork bulletin boards and other textured surfaces to break up flat wall planes are also desired.

Heat dissipation may be a problem if the machines units are clustered in one small room. Modifications of existing spaces should be planned to avoid this problem.

The total laboratory as planned is sufficiently flexible to house a small computer if this alternative is pursued rather than connecting a remote terminal to a central computer unit housed elsewhere. A portion of the space allocated to planning and programing could be used to house the computer which will require a 110-220 volt outlet and the possibility of cable connection to additional terminals and the remote units shown in the schematics.

SUGGESTED COMPUTER LABORATORY FUNCTIONAL ZONES



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SUGGESTED COMPUTER LABORATORY

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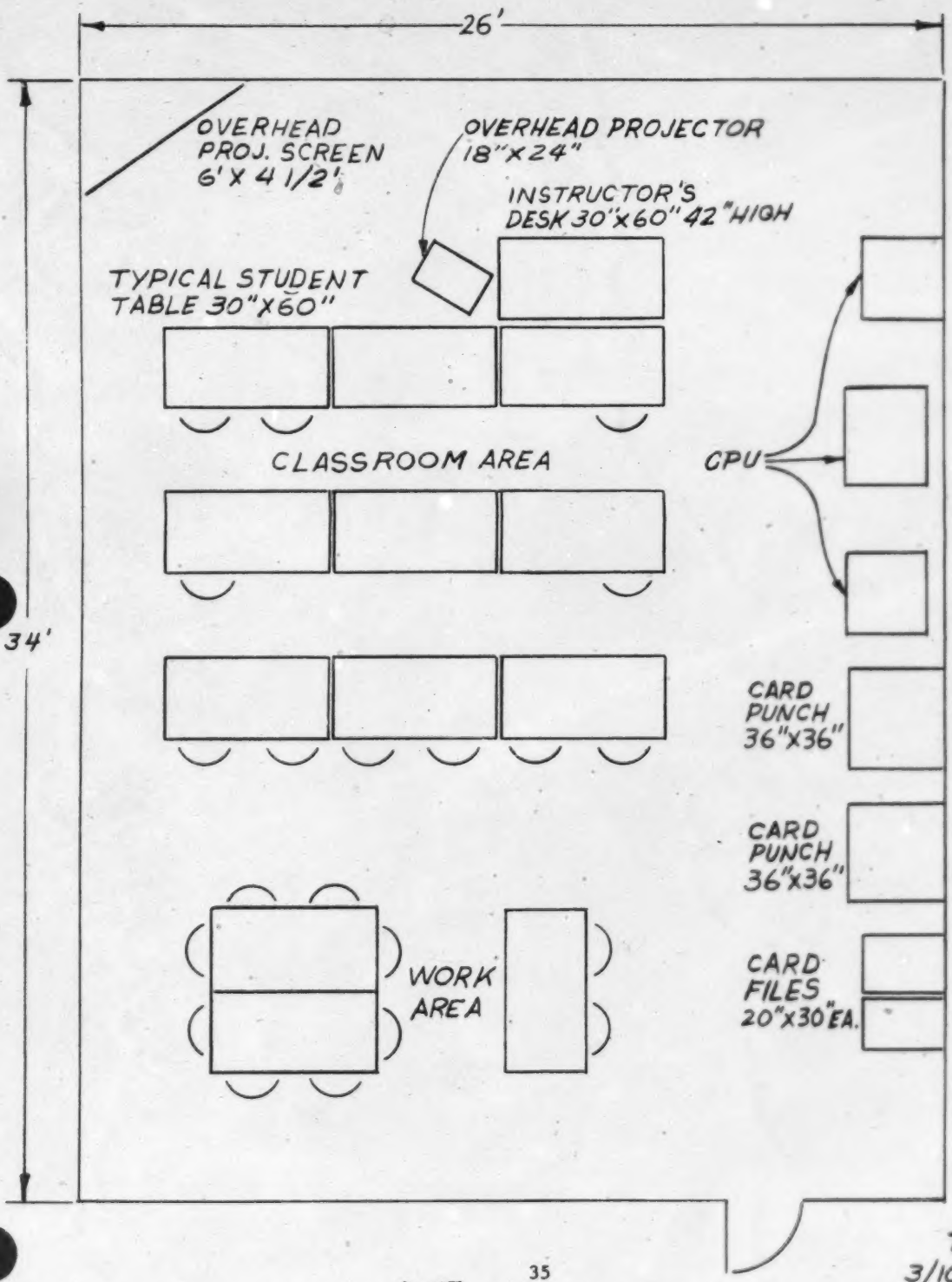

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